Marka-Sweep 154-C Multi-Sweep 159-C

KAY ELECTRIC CO.

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OPERATORS MANUAL
ISSUE C

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MARKA-SWEEP 154C

MULTI-SWEEP 159C

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SECTION I
PRELIMINARY INFORMATION

1.1 INTRODUCTION

The Multi-Sweep 159-C and Marka-Sweep 154-C are wide band sweeping oscillators composed entirely of solid-state circuitry with the added advantage of plug-in circuit boards. The 154-C provides a continuously variable sweep from 50KHz to 110MHz at an output of 1 V RMS. A single sweep of 1 MHz to 300 MHz at 0.5V RMS is provided by the 159-C.

PM7650 and PM7660 plug-in heads are available, providing pulse or birdie (CW or Harmonic) markers at customer specified frequencies, for both instruments. Markers with either unit are available from separate output terminals to isolate them from the circuits under test. Additionally, they may be combined with the RF output for long distance transmission, etc.

Both units utilize beat-frequency techniques to provide the wide sweep widths. High frequency sweeps are generated and lowered, by heterodyning, to the output desired. A fast acting ALC circuit is employed to hold the output flat to $\pm$0.25 db. A fixed repetition rate, locked to the line frequency, is used for general applications. Variable repetition rates from .01 Hz to 1000 Hz are available in five switchable ranges. A manual control is provided to allow the operator to vary the frequency at any rate. These units will also function as CW oscillators.

An externally applied signal may be used for the modulation of the sweep oscillators. Rates from DC to approximately 15 KHz at 1V p/p may be used. Both instruments employ DC sweep circuits permitting their use as voltage controlled oscillators over their entire range.

Designed as a bench-top unit, the 154-C or 159-C may be removed from its cabinet and be mounted in a standard 19 inch relay rack. The electronically regulated low-voltage power supply operates from 117V 50/60 Hz.

1.2 INSTALLATION

Unpacking: Upon receipt of the instrument visually inspect it for any damage that might have occured during shipment. Please report any damage to the carrier and to the Kay Electric Company.

Operating Notes: These instruments are designed for general use, in an environment reasonably constant in temperature and humidity. The ventilation grating will provide adequate air circulation for normal bench-top operation if it is left unobstructed. In any test operation using these instruments, impedance matching networks should be used where input and output impedances of the apparatus differ substantially. Also, the exclusive use of coaxial or shielded cables and connectors will eliminate any stray pick-up. These few precautions will insure optimum performance and stability from the Marka-Sweep 154-C and Multi-Sweep 159-C. Other information concerning interconnection of the equipment is included in Section III of this manual.

1.3 SPECIFICATIONS

	154-C	159-C
FREQUENCY RANGE	50 KHz - 110 MHz Continuously Variable	1 MHz - 300 MHz Continuously Variable
SWEEP WIDTH *	50 KHz - 110 MHz Continuously Variable	200 KHz to 300 MHz Continuously Variable
CENTER FREQUENCY	50 KHz - 110 MHz Continuously Variable	1 MHz - 300 MHz Continuously Variable
FLATNESS	±0.25 DB	±0.25 DB
RF OUTPUT	1.0V RMS into 50Ω, metered (75Ω on request)	0.5V RMS into 50Ω, metered (75Ω on request)
REPETITION RATES	Line Lock or Variable from 0.1 - 1000 Hz Switchable. Manual Sweep, External Modulation.	
BLANKING	Zero-Voltage baseline during retrace time, Switchable.	
SWEEP OUTPUT	Approximately 10 V p-p triangular wave. Slope ratio adjustable. Sweep direction reversible.	
ATTENUATION	20, 20, 20, 10, 6, and 3 db steps plus 3 db variable.	
HARMONIC DISTORTION	Better than 30 db down.	
SPURIOUS DISTORTION	Better than 30 db down.	
ALC	External or Internal. Switchable.	
MARKERS	Provision for birdie-bypass markers provided by external oscillator. Crystal - controlled pulse or birdie markers available in plug-in units.	
DETECTOR	Built-in. 50 ohms (75Ω on request).	
POWER REQUIREMENTS	117 V ±10% 50/60 Hz 230 V ±10% 50/60 Hz	

*(Note: In the 100-1000 Hz range full sweep width is not available at the higher repetition rates. With blanking OFF the maximum useable sweep is approx. 50 MHz at 1000 Hz).

SECTION II
OPERATING CONTROLS AND TERMINALS

2.1 OPERATING CONTROLS

CONTROL	POSITION	FUNCTION
POWER SWITCH	ON	Line Voltage applied to power transformer.
	OFF	Instrument completely de-energized.
FUNCTION	EXT	An external signal may be used to modulate the sweep oscillator.
	CW	A CW signal, variable over the range of the instrument, is available at the RF OUT terminal.
	MAN	Control used to vary or hold the oscillator frequency anywhere within the range of the instrument.
	VAR	May be used to select a rep rate between limits determined by sweep rate switch.
	LINE LOCK	Repetition rate held to power line frequency.
CENTER FREQUENCY	Digital Read-out	Indicates the approximate center frequency of the swept RF, or of the CW signal.
SWEEP RATE	Variable	Allows variation of sweep rate determined by setting of range switch.
	RANGE	Selects one of five ranges .01-1000 Hz (.01-0.1, 0.1-1, 1-10, 10-100, 100-1000).
MANUAL SWEEP	Variable	Frequency of RF signal and of the sweep voltage controlled manually.
ZERO ADJ	Variable	Provides a means of calibrating the center frequency dial.
BLANKING	ON	RF output is blanked during the sweep retrace time producing a zero-voltage baseline.
	OFF	No zero-voltage baseline; oscillator traces a response curve in both forward and reverse directions.

CONTROL	POSITION	FUNCTION
SWEEP WIDTH Switch	X1	Sweep width may be varied over the entire range of the instrument.
	X0.1	Sweep width may be varied over 1/10 of the sweep range; provides finer control for narrow sweeps.
SWEEP WIDTH	Variable	Used with Sweep Width switch to control the limits of the sweep RF output. Also determines the range of the MANUAL SWEEP control.
RF LEVEL	Variable	Provides 3 db of attenuation.
MARKER	Level	Provides amplitude control of markers; both plug-in and rack.
	Gain	Provides independent birdie control. Allows use of external markers at low signal levels without distortion and noise.
ATTENUATOR Switches	Stepped	Permits insertion of additive, stepped attenuation.

2.2 TERMINALS

TERMINAL	FUNCTION
RF OUTPUT	Swept RF Output or CW available at this jack.
DETECTOR	Provided at an impedance which matches that of the RF output.
VERT	The detected swept output and markers are available at this jack.
HOR AND EXT MOD	A sawtooth signal, used to drive an oscilloscope, may be obtained at this jack. When the FUNCTION switch is used in EXT MOD, an external signal may be applied to sweep the unit.
MARKER INPUT	This jack will accept a signal from an external signal generator and display it as a marker on the detected output.

2.3 REAR PANEL CONTROLS

CONTROL	POSITION	FUNCTION
ALC	INT	Utilizes internal circuitry to maintain flat output.
	EXT	Allows the use of an external leveling detector to maintain output.
External ALC Offset	Variable	Provides for 0-4 V adjustment of EXT ALC.
Sweep Ratio	Variable	Adjusts triangular sweep waveform. Ratio from 1:1 to 10:1.
SWEEP Lo-Hi Hi-Lo Switch	Low-High (Normal)	Oscillator sweeps from low frequency to high frequency.
	High-Low	Oscillator sweeps from high frequency to low frequency.
Markers Switch	Bypass	Markers are available at the Vert jack or at the PIP OUT jack of the plug-in unit.
	INT	Markers are used to blank the swept RF signal at the marker frequencies. When using the PM-7650 plug-in, the markers appear as "suck-outs" on the RF output response curve.
LINE LOCK	Variable	Used to sync sweep to line frequency.

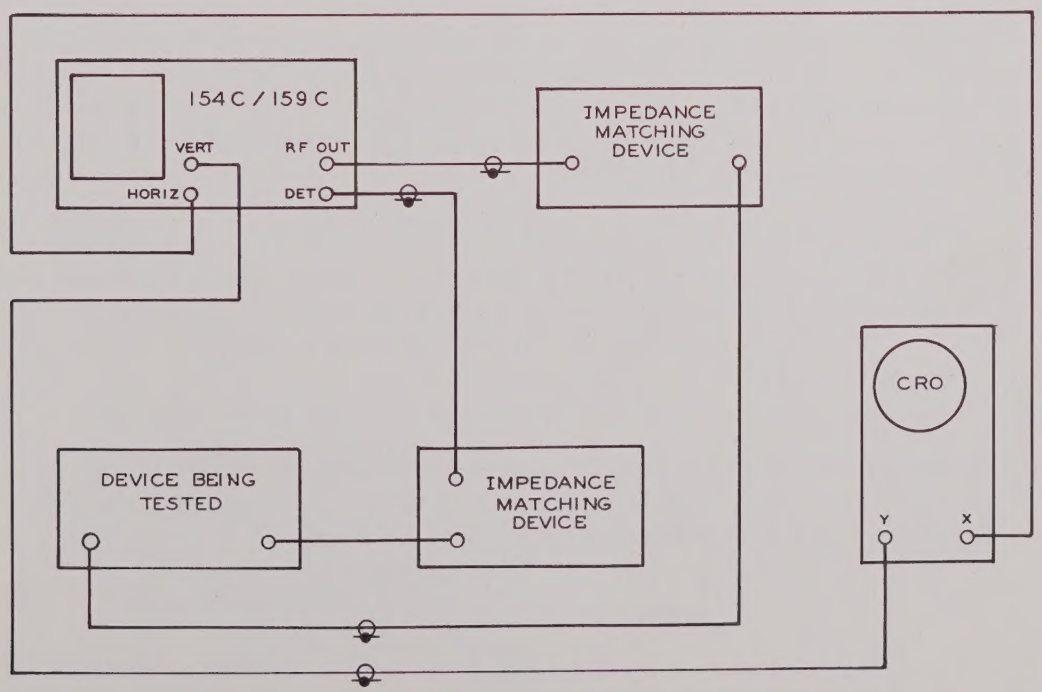


Fig. 2.1 TYPICAL INTERCONNECTION DIAGRAM

SECTION III
OPERATING PROCEDURE

3.1 INTRODUCTION

This section covers the operation of the 154-C and 159-C as sweep generators and CW oscillators. Their use as marker generators depends on the plug-in head being used, and the manual covering the head will be useful for determining their proper operation in such cases.

3.2 GENERAL OPERATING PROCEDURE

Connect the equipment as shown in Fig. 2.1. The FUNCTION switch should be set to the LINE LOCK position. Use the CENTER FREQUENCY control to adjust the 154-C or 159-C to the center of the pass-band of the device being tested. By using the SWEEP WIDTH controls, the desired amount of sweep may be displayed. In order to achieve a center frequency out to 110 MHz, adjust the ZERO-ADJ control to move the sweep over the necessary amount. To set the proper amount of RF output, the RF LEVEL control and the various steps of attenuation are used to provide adequate range.

3.3 VARIABLE REPETITION RATES

Repetition rates from .01 Hz to 1000 Hz are obtained by setting the FUNCTION switch to the VAR position and the SWEEP RATE to the desired range. Fine control, between the limits of the range, is achieved by using the SWEEP RATE VARIABLE control.

To utilize an external signal generator as a modulating signal, place the FUNCTION switch in the EXT position and connect the input to the HORIZ or EXT MOD jack on the unit. The external signal may be from DC to 15 KC at 1V p-p. For rates up to 400 Hz the sweep width will remain the full range of the instrument. The sweep circuits may be modulated above 400 Hz utilizing a fast detector and the internal sync of the oscilloscope (The ALC will not be effective above 400 cps and the sweep width will decrease as the frequency increases). A manual sweep may be obtained by placing the FUNCTION switch in the MAN position. The output of the instrument may now be controlled in the normal fashion using the CENTER FREQUENCY control, SWEEP WIDTH control and the SWEEP WIDTH switch.

The manual sweep position allows the operator to sweep any portion of a response curve at a rate determined only by the speed at which the control is rotated. This control allows the operator to find any position on the sweep he desires and then determine its exact position by the use of a counter. An X-Y recorder may also be used by keeping the rate slow enough.

3.4 BLANKING

By placing the BLANKING switch in the ON position, the output is blanked during the oscilloscope retrace time, displaying a zero-voltage baseline. Placing the switch in the OFF position allows the oscillator to trace a response curve in both directions.

3.5 VARIABLE MARKERS

Markers may be obtained by the use of external CW signal generators. To achieve this result, apply an external signal, at the desired frequency, to the MARKER INPUT jack. The amplitude of the markers may be adjusted by using the marker level and gain controls. The gain control allows high input signal levels to be used at low sweep outputs.

3.6 FIXED-FREQUENCY MARKERS

Fixed-frequency markers, supplied by a plug-in head, are available for use in both the 154-C and the 159-C.

3.7 BLANKING MARKERS

Placing the rear panel markers switch to INT allows internal blanking markers to be produced. Both fixed and variable markers may be obtained in this manner.

3.8 INTERNAL DETECTOR

An internal detector is provided in both instruments. This detector is used normally to check the operation of the SWEEP GENERATOR.

3.9 CW GENERATOR

The 154-C and 159-C may be operated as CW generators by placing the FUNCTION switch in the CW position. The CENTER FREQUENCY dial will indicate the output of the unit. Output levels may be controlled in the normal fashion.

To obtain a more accurate frequency, the ZERO ADJ control may be used. Set the controls as follows:

SWEEP WIDTH control - MINIMUM
FUNCTION - LINE LOCK
CENTER FREQUENCY - 000

Now vary the ZERO ADJ control so as to display the center of the zero beat on the scope screen. The center frequency may also be calibrated by using a frequency counter or any accurate standard.

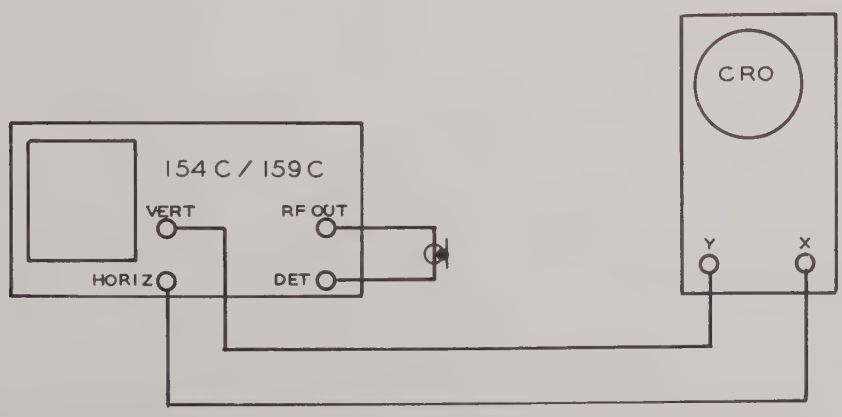


Fig. 3.1

SECTION IV
CHECK-OUT PROCEDURE

4.1 APPLICATIONS

The information contained in this section will enable the operator of the 154-C or 159-C to perform a general, overall check of his unit. These check-outs can be applied whenever:

a. The unit is initially received.
b. The unit undergoes preventative maintenance
c. Any components have been replaced.

4.2 CHECK-OUT PROCEDURE 154-C and 159-C

Equipment Required:

Oscilloscope - Tektronix Mod. 503 or equiv.
Oscilloscope - Tektronix Mod. 545 or 543 with Type CA-Plug-in or equiv.
CW Generators (2) - Kay Electric Utilator 990-A or equiv.
RF Power Meter with Bolometer mount or RF Voltmeter.
0.1 db Step Attenuator - Kay Electric 1/432 or equiv.
50 KC Absorption Type Wavetrap.
(Tuned Detectors - 50, 75, 100 MC - See Text)

A. SWEEP CIRCUITS

1. Connect HOR AND EXT MOD jack to vertical input terminals of the oscilloscope. Set the scope to internal sweep.

2. Set the FUNCTION switch to VAR and the SWEEP RATE control to each range. See that the amplitude exceeds 8 volts peak-to-peak.

3. Set the FUNCTION SELECTOR to LINE LOCK and see that the sawtooth signal is locked to the line frequency and the amplitude exceeds 8 volts peak-to-peak.

4. Place the sweep switch (located on the rear of the unit) in the REV position. Repeat steps 2 and 3 and see that the amplitude exceeds 8 volts peak-to-peak. Replace the sweep switch in NORMAL position.

5. Set the FUNCTION SELECTOR to MAN SWP and see that the MANUAL SWEEP control provides a DC swing equal to or greater than that of the VAR SWP.

B. RF OUTPUT, AGC, AND METER CIRCUITS

1. Interconnect equipment as in Fig. 4.1.

2. Disconnect the RF attenuator from the RF OUT jack.

3. Set panel controls as follows:

	154-C	159-C
FUNCTION SELECTOR	CW	CW
CENTER FREQUENCY	50 MC	150 MC

4. Adjust the RF LEVEL control for a reading of (1) (0.5 V - 159-C) volt on the RF output meter and see that the RF measuring device indicates 10 MW (5 MW - 159-C).

5. Vary the center frequency control over its entire range. The output be flat within ±0.25 DB.

6. Rotate the RF LEVEL control fully CCW. See that the output decreases approximately 3 DB. Repeat step 5.

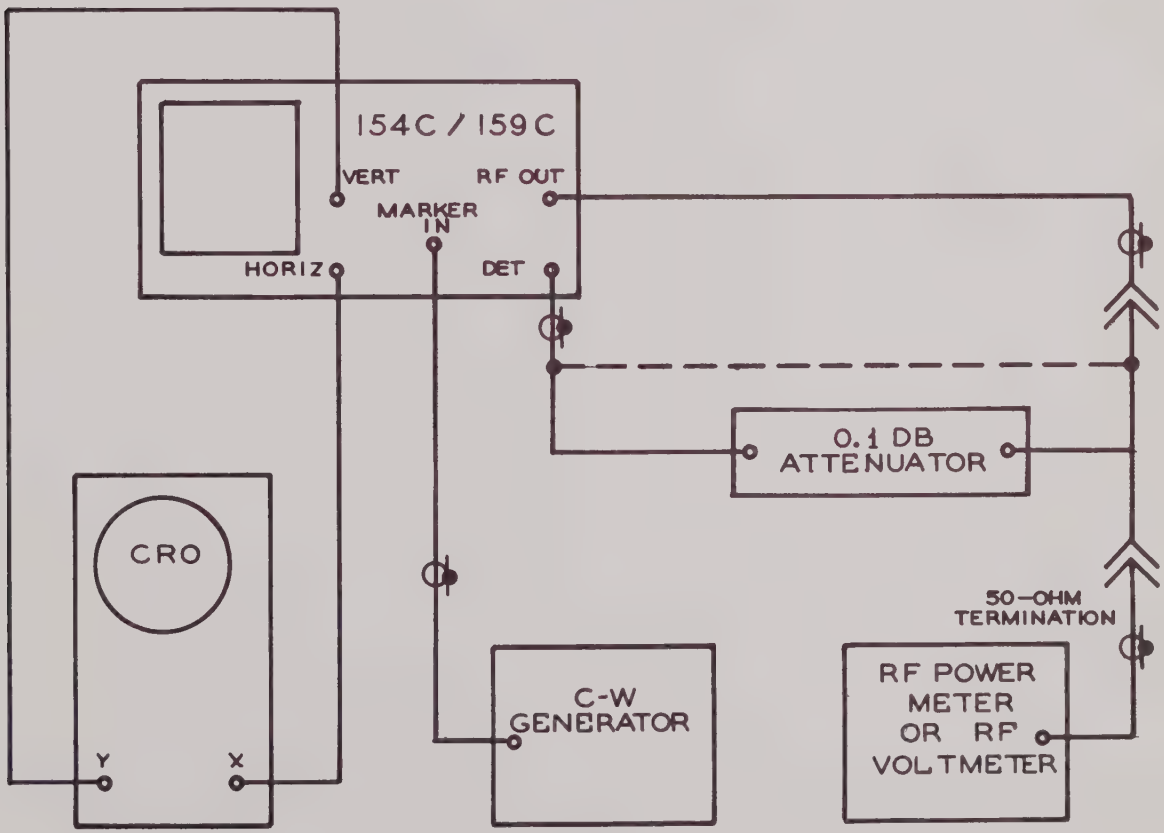


Fig. 4.1

C. SWEEP WIDTH CHECK

1. Disconnect the RF measuring device and provide a connection between the RF OUTPUT and the DETECTOR jack. Set CW generator to 50 MHz (150 MHz - 159-C) and turn up marker gain. Set FUNCTION SELECTOR to LINE LOCK.

2. See that the 50 KHz to 110 MHz (1-300 MHz - 159-C) portion of the sweep comprises about 80% of the response.

D. LINEARITY AND DIAL CALIBRATION

1. Interconnect equipment as in Fig. 4.2.
   NOTE: If available, a plug-in marker head that includes a 10 MC crystal may be used in place of the external generator.

2. Set FUNCTION SELECTOR to LINE LOCK.

3. Set output of CW generator #1 at 50 MHz (150 MHz - 159-C), and output of #2 at 10 MHz (30 MHz - 159-C). Center the horizontal sweep on the oscilloscope screen.

4. Adjust CENTER FREQUENCY dial and see that the frequency markers are properly positioned, as shown in Fig. 4.3. A typical accuracy is within ±5% of full sweep.

5. Turn the SWEEP WIDTH control to minimum and turn CENTER FREQUENCY dial to 000. See that the zero beat is centered on the oscilloscope. If not, adjust ZERO ADJ control. The dial should be accurate within ±1 MC (3 MC - 159-C).

6. Turn the CENTER FREQUENCY dial through its range, stopping at 10 MHz points. Observe that birdies occur on the scope screen at each 10 MHz (30 MHz - 159-C) interval, approximately.

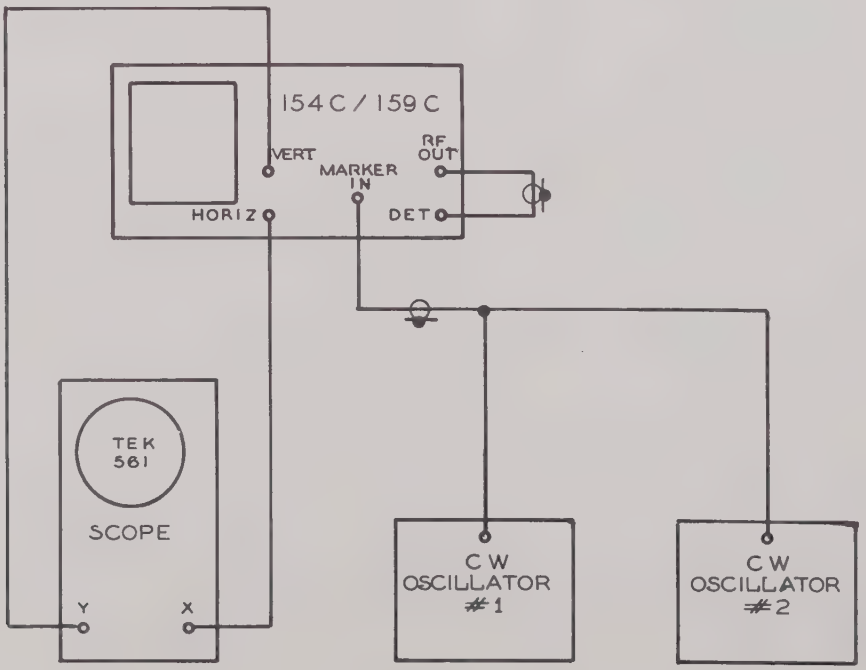


Fig. 4.2

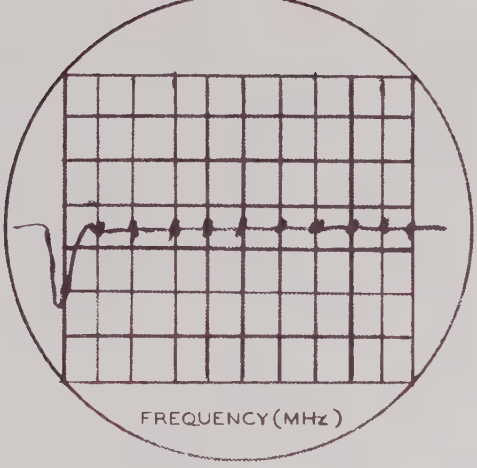


Fig. 4.3

E. LOW-FREQUENCY CHECK

1. Interconnect equipment as in Fig. 4.4.
2. Set FUNCTION SELECTOR to LINE LOCK.
3. Adjust the CENTER FREQUENCY and SWEEP WIDTH controls until it is possible to observe the zero beat and the 50 KHz (1MHz) mark on the response curve.
4. Check to see that the 50 KHz (1 MHz) mark falls to the right of the zero beat.
5. Place the Sweep Direction switch in REV and repeat step 4.

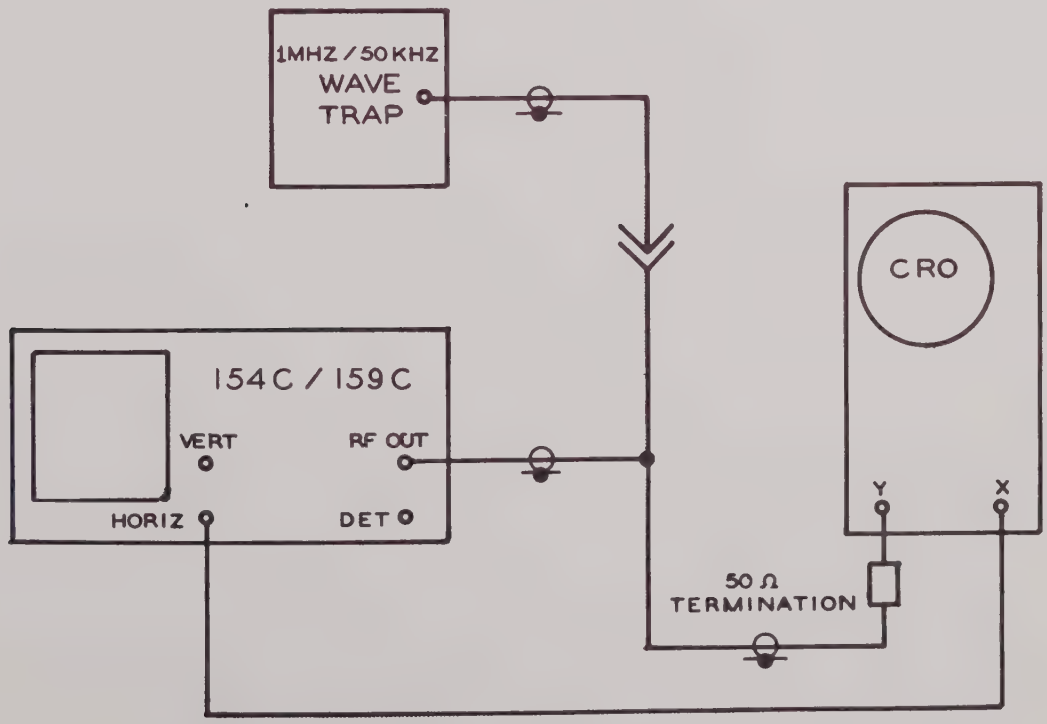
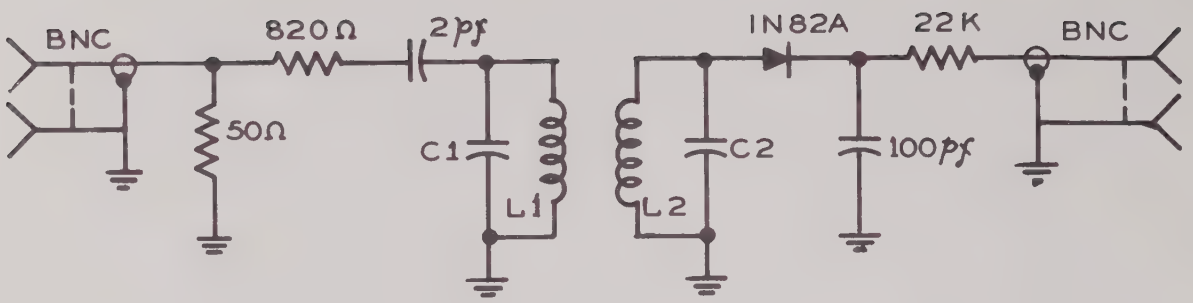


Fig. 4.4



NOTE: C1, C2, & L1, L2, SELECTED FOR RESONANT FREQUENCY OF TUNED DETECTOR

Fig. 4.5 TUNED DETECTOR

F. DISTORTION CHECK

1. Set FUNCTION SELECTOR to LINE LOCK, and RF LEVEL to 1.0 volts RMS.

2. Connect the RF OUTPUT to a 0-40DB attenuator, whose output is fed to a tuned detector (See Fig. 4-5).

3. Using an oscilloscope across the output of the detector, you should see a display similar to Fig. 4.6.

4. Switch in attenuation until fundamental equals second harmonic, this should be at least 30DB.

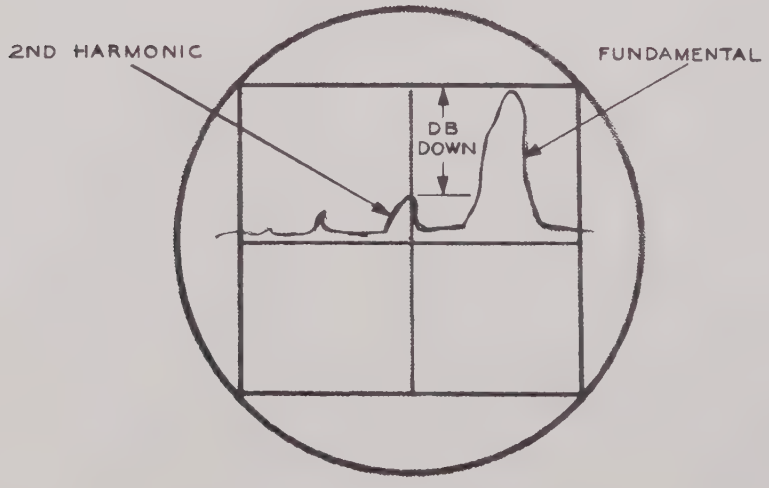


Fig. 4.6 DISTORTION WAVEFORM

ADDENDUM

FAA-E-2280

This addendum covers all units designated Marka-Sweep 154-CFA, and modified as per Federal Aviation Agency Specification FAA-E-2280.

SECTION I:

Change all references from 154-C to 154-CFA.
Delete all references to variable repetition rates (0.1) to 1000 Hz) and add repetition rate variable from 5 to 65 Hz.

Specifications:

Change:	From	To
Frequency Range	50 KHz - 110 MHz	50 KHz - 100 MHz
Center Frequency	50 KHz - 100 MHz Continously Variable	50 KHz - 100 MHz Continously Variable
RF Output	1.0 vrms into 50 ohms	1.0 vrms into 50 or 75 ohms
Repetition Rates	Line Lock, Variable from 0.1 to 1000 Hz, Manual Sweep, Ext. Mod.	Line Lock, Variable from 5 - 65 Hz, Manual Sweep, Ext. Mod.
Detector	Built in 50Ω (75Ω on Request)	Built in 50 and 75Ω

SECTION II:

2.1 Operating Controls:

Function Switch: VAR may be used with VAR REPRATE pot to provide sweep rates from 5 - 65 Hz.

VARIABLE REP RATE: Adjusts for a up rate range of 5 - 65 Hz.

2.2 Terminals

In addition to the existing controls, the following have been added:

1. RF Output Switch: Switch to select between 50 or 75Ω output.
2. 50Ω Output Jack: Swept RF or CW output at 50Ω impedance available at this jack.
3. 75Ω Output Jack: Swept RF or CW output at 75Ω impedance available at this jack.

SECTION III:

Delete references in Para. 3.3 to variable rep rates from 0.1 to 1000 Hz and add rates from 5 - 65 Hz.